

MEMOIRS

FOR THE

INGENIOUS

CONTAINING

Several Curious Observations in *Philosophy*,
Mathematicks, *Physick*, *History*, *Philology*, and
other Arts and Sciences.

IN

Miscellaneous Letters.

By J. DE LA CROSE, Eccl. Angl. Presb.

SEPTEMBER, 1693.

To be continued Monthly.

VOL. I.

Χρόνος τε καὶ πόνος τ' ἀληθὲς ἐκλαμπεῖ, ἀγαθὸν πρᾶξι καὶ λόγῳ βοηθῶν.

Truth breaks out by time and industry, provided it meet with a good
help. Clemens Alexandrinus, l. i. Stom. nat.

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MEMOIRS

OF

THE

LIFE

OF

JOHN

WILSON

BY

J. WILSON

Memoirs for the Ingenious.

SEPTEMBER, 1693.

LETTER XXXVI.

To the Honour'd Sir *Theodore de Vaux*,
Physician in Ordinary to the late
King *Charles II.* and to *Katherine*
Queen Dowager, Fellow of the Roy-
al Society, &c.

ARGUMENT.

A Commendation of my Lord Duke of Norfolk. Description of the Volatil Salts of the Stones taken out of a Man's Bladder or Loins; Of the fix'd Salts; What effect they produce upon the Blood; Of the Oil. Those Salts have no conformity with common Salt. Proportion of the Stone, with its Caput Mortuum. Description of the Stone it self. Of the formation of Stones in the ground. Men cannot altogether be cur'd of the Stone without being cut. Why the Stone cannot be dissolv'd in the Body of Men? How to try such a Menstruum? The Egyptians way of extracting the Stone. Remarkable Histories. An Infalible way of knowing whether one has the Stone or not. Of the Causes of the Stone, and by the by of the Gout; That both proceed from a petrifying ferment.

P p

How

How to assure our selves of it, and to come to a more distinct knowledge of that ferment? A strange Phenomenon.

Honour'd Sir,

THough you had not bestow'd a signal favour upon me, by enriching me with yours, and Sir *Theodore de Mayern's* Remarks on several subjects, yet the rank you have still kept both in the Civil and Learned World, would make me glad of being acquainted with you, to have an opportunity to offer you one of my Letters. You was pleas'd to honour me with the first visit, which I can ascribe to no other cause but your usual desire of promoting Learning. This, Sir, is not unknown to me, tho a Foreigner. The Royal Society, and the University of *Oxford*, are yet sensible of the obligation you put upon them, when you perswaded my Lord Duke of *Norfolk* to present the former with his fine Library, and the latter with those curious Marble Inscriptions, that are still round about the Theatre, with the two first Letters of his Grace's Name, *H. H. Henry Howard*, Engraven upon them. And as these Magnificent Gifts will be an everlasting Monument of this Noble Peers Fame, so they will be withal a Pattern for the Friends and Counsellors of the Great, to what things they ought to advise them.

But I supersede, lest I should offend your Modesty, and come now to the observations I have promis'd you upon the Stone in the Loins or Bladder.

As I was perusing some of Mr. *Leeuwenhoek's* Papers which I have by me, I found several sorts of trials that he has made upon such Stones as were taken out of a Man's Bladder when he was cut. 1. He put one of these Stones in a Glass-receiver, and by the strength of Fire extracted out of it the Volatil Salt and Oil. Upon this extract he pour'd clean Rain-water, which presently mix'd with it; then giving time to the Water to evaporate in part, there remain'd an unimaginable number of Salt Particles, all so very little, that many thousands of them would, perhaps, not have amounted to the bulk of an ordinary grain of Sand; so that their various Figures were altogether imperceptible, even with the best Microscope. But by some Particles which had remain'd sticking at the sides of the Vial, he observ'd that many of them were oblong, thick in the middle, and sharp pointed at both ends; others resembled little Parallelograms, and others again had the figure of a *Trapeze*, a *Pentagone*, an *Hexagone*, and *Heptagone*, but they were all as glittering and bright

bright as Chrystal. He kept that Water several days in his Clofet, and perceiv'd that it did not evaporate but with great difficulty.

2. He likewise pour'd clean Rain-water on the *Caput Mortuum*, or the remaining parts of the Stone, which lay burnt to pieces at the bottom of the Receiver. Then draining those Ashes by giving passage to the Water, he observed in it, after it was partly evaporated, a prodigious number of fix'd Salt Particles, which in many places coagulated together, in the form of the Sun-flower; however so as that each of them preserv'd its proper Figure. Other Salt Particles lay unevenly upon one another, and others again separately. Some would grow liquid by a moderate heat, and the heat abating transform again into Salt Particles, but a strong Fire made them harder, and those that were like the Sun-flower were altogether unchangeable.

3. He mix'd of his Blood with the Water drain'd out of the *Caput Mortuum*, and perceiv'd that by this mixture, the Globules of Blood, which give it a red colour, took most of them a particular Figure; as tho by a Foreign heat the Natural moisture had been driven out of them. He also mix'd of his Blood with that Water in which the Volatil Salt was melted, whereupon follow'd such a change in the Globules of Blood, as that they were no longer distinguishable; especially when the quantity of the Water exceeded by much that of the Blood.

4. The Volatil Oil extracted by that distillation is yellow, and mix'd with so many Salt Particles, that it is not fluid.

5. Both Volatil and fix'd Salt Particles are as bright as Chrystal, but all so very hard, that they do not melt by cold and wet weather; neither have they any conformity with the Particles of common Salt, which, tho never so well distill'd, preserve their own original Figures, and are easily melted by the moisture of the Air.

6. Amongst the Volatil Salt is an Earthy matter, that will not incorporate with Water, nor change its Nature even by Distillation.

7. The Stone before the distillation is to the remaining Ashes or *Caput Mortuum*, as 29 to 10; so that 19 parts are either consum'd, or go over to the Volatil Salt and Oil. Water being poured on the said Ashes, and drain'd out of them, they lose again two parts; so that upon the whole, there remains but 8 parts of 29. The same Proportion and Phenomena, our Author has observ'd in four or five other Stones, which he has Distill'd or Calcinated in the like manner.

8. He took one of these Stones Uncalcinated, broke it with a Hammer, and reduc'd part of it into a fine Powder, whereupon he pour'd clean Water, and made it boil in a Receiver, that some of the Volatil and fix'd Salts might incorporate with it. The Liquor being cold, and the gross matter sunk to the bottom of the Glass, he mix'd of his Blood with the Water that swam at the Superficies, and observ'd no other change in it, but such as common Water uses to make in Blood, *viz.* to dilute or make it thinner. However, afterwards he perceiv'd in this Water a vast number of Volatil Salts of an incredible smallness.

9. Mr. *Leenwenhoek* has not only observ'd with his Microscopes the Figure of the insensible Salt Particles, whether Volatil or fix'd, but also the shape of the Stones themselves. Even those that appear smoothest are made up of Scales, or little thin Leaves lying upon each other, and are seen through the Magnifying-glass as a heap of small Grains of Sand, glittering here and there, by reason of the Salts mix'd amongst them, which also are apparent on the sides, or extremities of these Scales.

These Observations would be as profitable as they are curious, if they could bring us to a right understanding of the Causes and Nature of the Stone. I'll try here what I can do, leaving it to you, Sir, and other Excellent Physicians, to correct and improve my Thoughts.

The hardest Stones, as Marble and Diamonds, are not one solid and continued body, but an aggregate of several Corpuscles to a vast and indefinite number, which the more compact and contiguous they are, or the less Pores they leave amongst them, the harder and heavier is the whole. But what is most admirable of all, is, that hard and heavy Bodies preserve these Qualities even in insensible Particles; for 'tis known, that not only Wood, but the very Marble and Diamonds, have some certain Grains or Veins, that is, a determinate tendency of their Fibres, or of the thin plates they are made of, along which they may easily be split, if the Workman hits happily at them. On the other side, we know not better but that it is the same moisture of the Earth, which entering the Pores of a Seed, swells it up to a Plant, being transformed into the substance of the said Plant; the same moisture, I say, that joining it self to the Principles of a Stone, serves to its increase. This conjecture is as probable as any Physical Hypothesis; for we see in a little spot of Ground a Stone and a Plant growing together, neither have we any reason to doubt whether the drops of Rain that fall upon it be of the same Nature, nor can we presume any diversity of Soil.

Soil in such a little parcel of Earth, considering the small depth to which the Rain penetrates. Add to this, that 'tis not possible to conceive how the various complication of the moist Particles of the Earth, suppos'd to be Homogeneous, can produce bodies of such a different Nature as are Herbs, Plants, Trees, Stones, Metals, Minerals, &c.

This, Sir, is a mournful consideration for some Men, because from thence it plainly follows, that there is a Principle in Stones as well as in Plants and Animals, and generally in all growing bodies, which transmutes into its own substance the adventitious matter; And consequently, that it's as impossible to prevent the formation of the Stone in Mens Bladder or Loins, when there is a disposition, or a principle proper to produce it, as it is to hinder the growth of Weeds and Stones in a Field. The latter however can be performed; for the principles of Weeds and Stones can be exterminated, by often Manuring, over-turning and burning the Earth; but as Humane Bodies cannot be thus roughly dealt with, so I see no means to rid the Diseas'd of that troublesom and painful weight of the Stone, but the dangerous way of suffering themselves to be Cut.

We needed not to come to that woful Operation, if the Stone could be melted away by any inward Physick or outward Medicament; but this method is altogether Impracticable, if I am not mistaken; for it appears by Mr. *Leenwenhoek's* Experiments, 1. That the Stone consists of Volatil Salt Particles, which can indeed be separated, or extracted out of its substance, by the strength of Fire, and then dissolv'd in Water; but they have a propensity to unite again together, whatever be the quantity of the Water they swim in; and when they are coagulated again, neither Fire, Spirit of Wine, nor Campher, can separate them a second time. 2^{dly}. Even amongst the Volatil Salts, there is abundance of an Earthy matter, which neither Fire, nor any *Menstruum* known to us, can dissolve. 3^{dly}. The fix'd Salts are so very rigid, that after they have been extracted out of the *Caput Mortuum* by an infusion of Water, tho the Water be never so much boil'd, Fire it self can alter their Figure but inconsiderably. 4^{thly}. After all Distillations, Calcinations and Infusions whatever, there remains still a *Caput Mortuum*, which is almost a third part in proportion to the whole Stone. 5^{thly}. Of a Stone beaten to a very small Powder, there are but few Particles, in comparison to the whole, that can mix, and be carried away with boil'd Water. 6^{thly}. There are different *Menstruums* adapted to the various Pores and Configuration of Bodies. Thus *Aqua-Regalis* will dissolve Gold and not Silver; and contrariwise, *Aqua-Fortis* will

will dissolve Silver and not Gold; but both will Burn and Scar the Flesh. And therefore I cannot conceive how a *Menstruum* can penetrate so far as the Loins or the Bladder, and there dissolve the Stones, without offending so many tender Conduits, Fibres and Membranes, through which he must pass, or touch at in his way.

However, I have lately heard of a Chymist that pretends to have found out a cold *Menstruum*, by which he can melt the Stone; and I am credibly inform'd, that he has dissolv'd several extracted out of Mens Bodies in presence of Learn'd Physicians. It's added that he keeps his *Menstruum* as a Secret, hoping to bring it to that perfection as that it may be given, and produce the same effect inwardly. I am not acquainted with the Gentleman, but if my Papers come to his hands, I would advise him to try his Skill upon Dogs, which are subject to that Disease as well as Men; for if he can Cure some of these Beasts, he may then the more safely venture upon Mankind.

We ought to be the more cautious, that besides the Reasons and Experiments above-mentioned, to prove that this way of melting the Stone is almost impracticable, it is liable to many deceptions that are of very dangerous consequence. For as long as the Stone lies in its *Mucilaginous* Bed, the pain it causes is not so smarting; but if you drive away this *Mucilage*, or even extract some of the Volatil Salt and Oil out of the Stones, which is all, as I think, that can be produc'd by these pretended *Menstruums*, then the Stone having nothing to rest upon but the tender Fibres of the Loins and Bladder, will be the more ponderous and troublesome. So that, as to those who cannot resolve to be Cut, or are come to that Age that this violent Operation would expose their Lives to an eminent danger, the best method they can take is to avoid all strong Purgatives and Diureticks, as well as all manner of excess, and to keep their Body open by soft Medicines, that may prevent as much as possible the heaping up of gross humours, or their petrification. The famous Sir *Theodore de Mayerne* was of that Opinion, as are also all the Learned Physicians of *France*, and those of *England* too, as far as I can judge.

(1) De Medicina Ægyptior. l. 5. c. 14. Prosper Alpinus^a relates that whilst he was in *Ægypt*, he saw one Haly an Arab take the Stone out of a Turkish Commander call'd Horam Bey, in the following manner. He put a Pipe of 8 Fingers in length, and of the bulk of an Inch, in the Canal of the Yard, through which he blew with all his power, squeezing with the other Hand the extremity of the Natural part towards the *Periny*, lest the Wind should enter into the Bladder. Then he stop'd the Mouth of the Pipe,

Pipe, that the *Ureters* might swell up and enlarge. In the mean while his Servant thrusting his Finger through the *Anus*, made the Stone advance by degrees towards the Neck of the Bladder and the beginning of the *Ureters*. This Operator no sooner felt the Stone to be near the *Periny*, but he strongly and readily drew the Pipe out of the Canal of the Yard, extracting together a Stone as big as an Olive-stone. Our Author saw the same operation performed, by the same man, upon two *Jews*, viz. A Boy out of whom he took eight little Stones, and a man, out of whom he extracted another as big as an Olive.

Prosper Alpinus was too knowing and sincere, than that we should doubt of the truth of his relation. But I have two things to observe upon this subject. First, That this method is only of use, when the Stone is but small, or when there are many little ones instead of a great. Secondly, That this way is also liable to many deceptions. Sir *Theodore Cranen* testifies, that about the beginning of this age, an *Irish* Woman went through *Scotland*, boasting to have found the Art mentioned by *Alpinus*, for extracting of the Stone without incision. But instead of taking out the true Stone, she extracted counterfeit ones, made of Sand mix'd with *Therebinthin*, Wax, Resine, or some such matter, which she blew through a Pipe into the dilated *Ureters*.

Tho the Stones of men be not for the most part so smooth and hard as Flints; yet had the diseas'd *Scotch* had some more insight in Anatomy, they would not easily have been impos'd upon by this Woman: For such a factitious Stone has little or no resemblance with the true ones. But some men are so fanciful and childish, that as to them deception is a charitable Office. Such was that Gentleman, who would not be perswaded by all the reasons of your learned Godfather, that he had not the Stone. Mr. *de Mayerne*, seeing no arguments could prevail upon him, promis'd at last to cure him; caus'd two Bottles of *Rhenish* to be fetch'd, wherein he put some drops of Spirit of Salt Ammoniac, as a thing of great virtue, and gave him that Wine to drink. Soon after the Gentleman wanted a Chamber-pot, which was brought up, and into which Sir *Theodore de Mayerne* let dexterously a Stone slip. Then, when it was almost full, let's see, said the Doctor, putting his Spectacles most gravely on, whether our Physic has operated? And looking into the Chamber-pot, well, pursued he, the work is done; see, Sir, there is a Stone: The Gentleman staring and amaz'd, own'd himself to be cur'd, and left Sir *Theodore*, (who would accept of no Fees,) with a thousand thanks.

The

The strength of the imagination is so very great, that it sometimes produces its effect, even upon those that are really sick. The Tooth ach is a very acute pain; however I have often try'd, that being taken up with business of great consequence in my station, the pain would diminish by degrees, and at last entirely vanish, if I did not mind it; but then it returned when I was in bed. And generally we know that in all Diseases, which allow of talking, reading or playing, diversion is one of the best lenitives: And that the imagination exerts its power even over the smarting pains of the Stone, I may convince the Reader by a testimony beyond contradiction, since it is that of his Royal Highness, Prince George of Denmark. A Danish Lord, who was troubled with the Stone, resolv'd to be cut; but the Chyrurgion, who was none of the most skilful, not finding the Stone, had another ready in his hands, which he shew'd to the Patient: Hereupon the Wound was clos'd up, and this Nobleman was well during three years; at the end of which, the pain began anew more violently than ever; so that he was forc'd to undergo a second operation. But at this time he had the good fortune to meet with an able Chyrurgion, who really took out of his body a Stone of a considerable bigness.

I confess that most of the *Diagnostick* signs of the Stone are equivocal, and that the excrescency of a *Caruncle*, or piece of hardned Flesh in the Bladder, will produce the same symptoms as a real Stone. This was the case of your Neighbour, Captain *Blagrove* of *Whiton*, whom several Physicians and Chyrurgions perswaded that he had the Stone, whereupon he resolv'd to be cut; but tho the Operator was skilful enough, he could find no Stone at all. There is a certain way to know whether the Patient is troubled with the Stone, or not, *viz.* to introduce ones finger into the *Rectum*, or if the finger be not long enough, a hollow Probe called *Catheter*, must be thrust through the *Ureter* into the Bladder; then you will not fail to meet about the *Pubis*-bone with a hard body resounding as a Stone, if there be really one.

It were time I should say something concerning the causes of the Stone; but here I confess that I am at a loss. I might say as well as another that at the percolation that is made in the Reins, there are particles in the *Serum* too gross, hard and heavy to be carried away with the Urine, so that they fall down by their own weight towards the *Periny*. But this solution is too general to be satisfactory, and is besides liable to several difficulties. 1. Then all men should be subject to the Stone, which is altogether false. 2. If not all, then at least all such whose stomach is weak and the digestion imperfect; but

but this assertion is not more true than the former. For 'tis so far from that all cacochymick bodies should be troubled with that disease, that they are the more secure from it, as well as from the Gout. The Stony and Gouty use to live long, if they know how to manage their health; they are only sick by fits, and at other times are as sound as any other man. There is however an exception to be made as to the Stone: for the violence of the pain, and the frequent reiteration of the fits does often carry the diseased away. 3. The production of the Stone cannot properly be ascribed to any aliments, for it may be formed in all sorts of persons, Noblemen and Peasants, Rich and Poor, Sober and Debauch'd, Children and Women, Young and Aged People. 4. Neither can it be chiefly imputed to the Generation, no more than the Gout, as far as I conceive; for Diseases which chiefly proceed from that Original, come from the intemperateness and corruption of the Blood, from the weakness of all the Parts, from an ill habit and constitution of the whole Body. But we have seen that the Stony and Gouty are healthful enough, and that the interruption of their health is a consequent, and not an antecedent cause of their fits. 5. And therefore I am apt to believe that these two Plagues of mankind proceed both from a Ferment; but that in the Stony it lies in the Loyns or Bladder, where it insensibly dries and petrifies the grossest parts of the Lymph it mixes with; whereas in the Gouty, the Ferment lies in the joynts of the body, and there turns the grossest and most viscous Lymph into a kind of Chalk.

But what is this Ferment? Sir, I would give whatever I am, or ever shall be worth in this world, to know it perfectly; and then I would communicate that secret to the public, as freely as I do any of my thoughts in these *Memoirs*, my love for mankind is so great. But I despair to get it, in the state I now am. I shall perhaps some day or other enlarge a little more upon the Gout, and therefore shall confine this Letter to the Stone. Methinks that it is form'd in humane bodies, almost in the same way as Wood is petrify'd in some certain Springs. To make sure work, water a certain number of Dogs with this and no other water, and from time to time sound them with the Probe: If you find a Stone either in their Loins or Bladder, cut the Animals alive, take out the Stones and the mucilaginous Bed; distil each a part, as also the petrifying water; observe exactly the volatil Salt and Oil, the fix'd Salts, and the *Caput Mortuum*, both of the mucilage and of that water, whether you shall not discover any particles of the same nature with those of any known Mineral? For if we could come so far, the business was half done,

because knowing the true cause of that Disease, we should be in a fair way, either to prevent or to cure it. And yet I still doubt of the certainty of this method, because fire may so much alter the figure of those bodies, that they are not any longer knowable. Add to this, that since in every part of the world there are men troubled with that disease; whereas petrifying Springs are only proper to some particular Countries; 'tis not probable that the Stones should be form'd in men, by steams of the same nature with those that petrify Wood in Fountains. There must then be an *Austere* or *Astringent* ferment, such as the Juice of Queuce, squeez'd out of the Aliments, which ferment meeting with a Lymph apt to coagulate, petrifies it by degrees. The Principles of Generation, the Air, a Melancholy and Sedentary Life, and a thousand other accidents, may give such an aptness to the Lymph.

Since Phenomena, the truth of which cannot be doubted, are the most conducive means to a fundamental knowledge of the nature of Diseases, I shall close this Letter with a very surprizing event, that hapned here about *London*, for which *Sir Theodore de Mayerne* is my Author. A Gardener that was troubled with the Stone in the Bladder us'd to put a small Pipe of lead in the canal of his Yard, when he would make water. Once as he was in that situation, some body open'd unawares the door of his Chamber, which put him into such a fright, that the Lead-Pipe slip'd out of his hand, and entred into the Bladder, where it remain'd about two years. At the end of them, the poor man began to feel a great pain towards the Fundament, where rose a swelling, and something that thrust the *Anus*. An incision was made, and the Lead-pipe presently discover'd, which was extract'd together with the Stone, in the middle of which it stuck fast. One *Mr. Harris*, that was then Chyrurgion of *S. Bartholomew's Hospital*, brought this Stone and Lead-pipe to *Sir Theodore de Mayerne* to view them. The man was so well within a fortnight, that he work'd in his Garden as before: However the Wound was not clos'd up, for he must make water through the *Anus* all his life.

Septemb. 18th.

L E T.

LETTER XXXVII.

To the Reverend Dr. Hooper, Dean of
Canterbury.

ARGUMENT.

That no plain Answer can be given to a dark and compounded Question. Eight Questions imply'd in that only one, Whether there are Persons possess'd with an Evil Spirit, distinct from their own Souls? That there are Spirits or Substances distinct from Matter, demonstrated from Motion and Gravity. That the first Motor cannot be Matter. Whether the Peripateticks have any distinct notion of their Materia prima. The Incorporeity of God, and an Image of the H. Trinity. That there are good and bad Spirits. That they are of different Orders, and subordinate to each other. That all humane Souls are not alike. That all Spirits were created free. That Blessed and Damned Spirits are now rather spontaneous than free. Of the Liberty of Men. How God, Good and Bad Angels work upon humane Minds? Pretended possess'd are most of them meer Cheats. The necessity of Metaphysical Discussions.

Reverend Sir,

AS you were one of the first, who honoured me with his Friendship in England, so I ought to have given you one of the first places in these Memoirs. And I intreat you to believe, that neither forgetfulness nor ingratitude have made me defer so long what I ought to have paid you as soon as I began to write; but that I am ashamed to be known to men of so great parts, and to have so little to present them with; especially to you, Sir, of whom besides what

(a) William
Lloyd Bp.
of Coventry
and Litch-
field.

I know my self, I have heard one of the most learned and most sincere Prelates of our Church (a) tender this Testimony, that *England* might boast to have in you as great a man as any one that is beyond Sea.

It's not only want of knowledge and experience, of Books, Friends, Leisure, and other conveniences, that makes this undertaking a greater task than I can well perform, and would have caus'd me to lay it down, if I were not obliged to continue it; but my greatest discontent is, that what method soever I can take, I cannot please all my Readers. For there are some who desire a *Categorick*, or a plain and short Answer, to all the Questions they propose to me, which in many cases is as much as a plain contradiction. For instance, in reference to the present Constitution of the Commonwealth of Learning, the matter I have now in hand, *viz.* *Whether there are persons possess'd with an evil Spirit distinct from their own Soul?* depends upon the Solution of several preliminary Questions. As, 1. *Whether there are Spirits or Substances distinct from Matter?* 2. *Whether Spirits separated from all Matter can act upon Matter?* 3. *Whether those Spirits are good or bad, Friends or Enemies to Mankind, or whether there are of both sorts?* 4. *Whether there are different Orders of Spirits, and whether they are so far subordinate to each other, as that the power of a Superior Spirit may altogether suspend the operations of an Inferior?* 5. *Whether it follows, that evil Spirits have such a power, tho it were granted to the good, and how far that power extends?* 6. *What were the evil Spirits which our Saviour cast out whilst he liv'd upon Earth?* 7. *Supposing them to be real Substances, whether those malicious Demons have still power to plague Mankind with Possession, Witchcraft, and the like?* 8. *What are the distinguishing Characters of a true and false Possession?*

I. The first Question is demonstrable in the affirmative, *viz.* *That there are Spirits or Substances distinct from Matter.* If there be Motion in Nature, and Matter cannot move it self, there is a principle of motion distinct from Matter. But that Matter cannot move it self, appears from thence, that all Bodies are ponderous; which I prove thus. Gravity is the property of Bodies, by which they endeavour, as it were, to descend to the Center either of the Earth or of the World: But this endeavour or tendency is an effect either of their Knowledge, or of their natural Inactivity and Immobility. That it's not an effect of their Knowledge is plain, because those compound Bodies that seem to be endued with some sort of Knowledge, as living Creatures, are the most remote from
that

that tendency to the Center ; and that as soon as that Principle of Life is gone from them, they lie dead and unmoveable, and would descend to the Center were they not under-propt by other Bodies. And therefore the gravity of bodies, or their tendency to the Center, is an effect of their natural inactivity and immobility, and consequently Matter cannot move it self.

If it be objected, that all bodies are not ponderous, because we may observe some ascending and others descending. I answer, That not one body does really ascend, but that such as appear to do so are only thrust up wards, or hinder'd from descending lower by other compound bodies heavier than they are. For because, according to our Hypothesis and the reality of things, all Matter is ponderous and cannot move it self, it follows, that the more Matter is in compound bodies, the more ponderous and unmoveable they will be ; and therefore, that whensoever Matter is moved, such compound bodies as have less Matter in them will give room to the more compact, and so appear to ascend. Conformably to those Arguments, some Ingenious Philosophers of our Age, as *Borelli*, and the late Honourable *Robert Boyle*, have demonstrated, that such bodies, as were esteem'd to be naturally light, are really ponderous. Thus Smoak will descend in the *Torricellian* Tube, or in a Glass-Pipe exhausted of gross Air : Flame and Fire are ponderable several ways, &c.

II. The only remaining Subterfuge is, That tho Matter be unmoveable in it self, yet the Principle of Motion can be Matter, and withal something besides, that is, the first Motor. Nay, the Objectors pretend that it must needs be so, because, say they, they can no more conceive how a pure Spirit, or a Substance altogether separated from Matter, can act upon Matter, than how Man could be the cause of so many motions, if he had not a Material Body. This Objection encroaches upon the 2d Question, which indeed is not so easie to be determined as the first, however I hope to demonstrate the affirmative, viz. That there are pure Spirits, and that they can act upon Matter, if I can prove, 1. That there is something Incrated. 2. That Matter is Created. For thence evidently follow these three Propositions, 1. That the Incrated Being is a pure Spirit. 2. That the Incrated Being is the Creator of Matter. 3. And therefore that pure Spirits can act upon Matter.

As to the first, viz. That there is something Incrated, I prove it thus : We have an Idea of Sovereign Wisdom and Power ; for we can conceive a Wisdom so perfect, as that it never mistakes nor can mistake, and a Power so great, as that it can do whatever is fisible.

And

And therefore Sovereign Wisdom and Power, or rather the Being whose Attributes they are, is Increated. The Consequence is plain; for if Sovereign Wisdom and Power are not Increated, they must needs proceed, either from Matter, or from a more perfect Being; from Matter they cannot proceed, for we have seen that Matter is unactive and insensible in its own Nature; neither do they issue from a more perfect Being, for they are the Sovereign Wisdom and Power, than which nothing can be conceiv'd more perfect.

As to the second, That Matter is Created, I prove it thus: Whatever has a Principle of its motion distinct from it self, has a Principle of its Existence; but Matter has a Principle of its motion distinct from it self, because, as it hath been already prov'd, Matter cannot move it self; and therefore Matter has a Principle of its Existence. -- That which has no Principle of its existence is eternal, exists of its self, or has produc'd it self; but that which has a Principle of its motion distinct from it self, does not exist of it self, since it does not depend on it self as to its Manner of Being; neither can it have produc'd it self, or brought it self into Being, since it cannot bring it self into Action, and therefore Matter having a Principle of its motion distinct from it self, has also a Principle of its Existence, and consequently is Created.

Thence I conclude, that Spirits separated from all Matter can act upon Matter, since God, who is a pure Spirit, is the Creator of it, and governs it still by his Son and H. Ghost, his Infinite Wisdom and Power. But whether there are any other pure Spirits, or whether they are united to some parts of very thin and subtile Matter, to serve them instead of *Vehicles*, is what neither I, nor perhaps any Man living, can uncontestably determine. In the mean while my comfort is, That all the Phenomena may as easily be Solv'd by supposing that God gives to Spirits the power of moving a portion of Matter, as by conceiving that they are inseparably united to some other portion of Matter, by which means they may move a far greater part of it.

But I remember an Objection of the *Peripateticks* that seems to be worth answering: What you urge, say they, concerning the unmoveableness of Matter, is only true of Matter dispos'd into forms, of particular and separated bodies, or of aggregates of those bodies, and not of the first Matter, *Materia prima*, which is neither *quanta* nor *qualis*, nothing sensible or determinate, but a most pure and simple Essence. What Gibridg is this? Do those Gentlemen understand what they say? If they do, let them explain themselves in ordinary terms. If they cannot do it, why do they presume to affront

affront Mankind, and even our Sacred Religion, with such an Impertinent and Nonsensical Language?

If those Philosophers have any distinct Notion of their *Materia prima*, they must needs conceive it under the Idea of that infinite space, or intellectual extension, which I have describ'd in the 3d and 10th Letter of these Memoirs. But then it is so far from proving Matter to be Eternal, that it is an Invincible Argument for the Eternity and Incorporeity of God, and the Creation and Dependency of all finite Beings. For whatever is annihilable in its own Nature cannot be Eternal, since what exists of it self is independent, and that which can be annihilated depends upon him who can annihilate it. But all finite Beings are annihilable, for I can suppose them annihilated or non-existent: All, I say, besides these three, viz. an Infinite Wisdom, who resolves to annihilate or to create them, an Infinite Power, who performs it, and an Infinite Space that remains after their annihilation, and was before their creation. These three are Eternal and Self-existent, since they cannot so much as be annihilated even by supposition; and they are withal a Glorious Image of the ever blessed Trinity, the Father being that Immense-All, the Origin and Fountain of the Deity, the Father and the Creator of all, the Son his infinite Wisdom, and the H. Ghost his infinite Power. An Image that agrees well enough with the expressions of the H. Scripture. However, I dare not insist upon it, because the Sacred Writ speaks of the Father, Son, and H. Ghost, as of three distinct Persons or Subsistences, whereas Immensity, Infinite Wisdom, and Infinite Power, seem only to be three Attributes of the Deity, tho they be the chief ones, and the source of all the others. I am satisfy'd with this, That the Divine Revelation teaches me there are three Persons in God, and that my Reason assures me, this Mystery is so far from implying any contradiction, that three Divine Persons must of necessity have one and the same Nature and Substance. As to the manner of their Distinction, Subsistence and Unity, I leave it to that Day when the Prison of this Body shall be broken, when instead of seeing God through a Looking-glass, we shall contemplate him face to face.

III. The other Questions are not Metaphysically demonstrable, so that we must content our selves with what the H. Scripture, credible Relations, and our own Experience teaches us concerning them. The 3d is, Whether Spirits are good or bad, Friends or Enemies to Mankind. I answer, That there are of both sorts. As to the Infinite Being, none can doubt but that he is the Goodness it self, since

since he is the most perfect Being, and the source of all Perfections. And as to finite Spirits, the H. Writ speaks so plainly, and so often, of good and bad Angels and Spirits, that he must needs be very confident who presumes to deny the existence, or the operation of the latter, as I am inform'd that a late *Dutch* Author has done. But I suspend my Judgment, because I have not yet seen his Book. Besides the Sacred Authority, I am apt to believe that in the Spiritual World things go much alike as in this Corporeal; so that there are good Angels, blessed Souls, Devils, Hob-goblins, Damned Spirits, as we have here Just and Learned Men, Knaves and Fools. However there is this notable difference, That the degrees of Virtue and Wisdom, Wickedness and Folly, are probably much more consummate in Spirits free from Terrestrial Bodies than they are in us. 1. Because of the nicety of their Organs, if they be join'd to any Organical Body. 2dly. Because of the long time they may be suppos'd to have pass'd in that state.

IV. The fourth Question has two parts; As to the first, Whether there are different Orders of Spirits? I have already declar'd myself for the affirmative, in the XVII. Letter of these Memoirs, but never since met with any proof or objection that made me alter my thoughts. I am not ignorant that it's a common Opinion of the Protestants, that all Angels and Humane Souls are alike amongst them; and whereas we perceive a sensible difference betwixt the latter, this they pretend to Solve, by saying, That it only proceeds from the various conformation of the several bodies to which they are united, and especially of the Brain, which is afterwards increas'd by the diversity of Education. I know that in this state of Corporeity, the Soul is much depending upon the Body, tho I may sincerely protest, that never any outward accident that I can remember, did so far disturb my inward Constitution, as to benum, or even weaken my Understanding: (a) But as to Imagination and Memory, they have so great a relation with the Body, that I am sensible of a notable increase or decrease in them, according to its various alterations.

(a) See
Works
of the
Learned
Art. 58.

As to Education, and other exterior helps to Knowledge, I grant that they contribute very much to its Improvement; for our Understanding and Natural Light are like sparks of Fire, that will kindle sooner or latter, more or less violently, according as they are blown up, and as the combustible Matter that is put upon them is more or less dispos'd to take Fire. But that these outward Succours are not the chief Spring, whence flows that substantial Oil, which affords nourishment to the Eternal Lamp of our Minds, does plainly appear

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appear from thence, that we often see two Brothers born of the same Parents, and brought up in the same House, and with the same care, of whom one shall become a great Man, whilst the other shall remain a Blockhead, or a person of mean Parts. So that after all, the Objectors must have again recourse to the first evasion, *viz.* the different conformation of the Corporeal Organs; which indeed I cannot directly confute, because I know not the nature and inward configuration of the minutest particles of our bodies. But neither can they give direct proofs of their assertion, whereas the instance of two Brothers, sometimes so different in Learning and Virtue, tho' they have seen the light in the same climate, receiv'd life and breeding from the same Parents and Masters, and do not sensibly differ in Age, Health or Constitution: This instance, I say, is a strong presumption to the contrary.

Add to this. 1. That the Holy Writ gives several names to the blessed Spirits, calling them *Angels, Cherubims, Seraphims, Thrones, Dominations, Principalities and Powers, Psal. xviii. 10 Isa. vi. 2. Col. 1. 26.* Which seem not only to be names of Offices, but also of several Orders and Subordinations. Besides that, considering the infinite Wisdom of God, this difference of Offices does probably imply a difference of natural and acquir'd knowledge. 2. St. Paul speaking of the future State, infers from the Diversity of Corporeal Creatures, that there shall be a difference betwixt those who shall participate of the heavenly happiness. *All flesh, saith he, is not the same flesh, but there is one kind of flesh of Men, another flesh of Beasts, another of Fishes, and another of Birds. There are also Celestial Bodies and Bodies Terrestrial, but the glory of the Celestial is one, and the glory of the Terrestrial is another. There is one glory of the Sun, another of the Moon, and another glory of the Stars: For one Star differs from another Star in glory. So also is the Resurrection of the dead.. 1 Cor. xv. 39, 42.* It's true, the Apostle makes only use of the second similitude, that of the Celestial and Terrestrial Bodies; but 'tis plain enough how the others may be applied, and that they needs import a difference amongst holy men, after the Resurrection. However there shall then be no diversity of Air and Food, neither do I see any probable cause of a different conformation of their brain. 3. The stupendous variety of bodies, which makes us judge that their nature is different, is a strong inducement to believe that there is something alike amongst Spirits. For that variety of bodies is so great, that even two Apples of the same Tree differ in bigness, colour and savour, and the very grains of sand, that seem so alike do sensibly differ in bulk, colour, transparency and figure, when view'd through a good Microscope.

And were our Eyes more piercing, and other Senses less dull, doubtless we should perceive a greater diversity betwixt Bodies. 4. Supernatural Gifts are all different, as *S. Paul* teaches, *1 Cor. xii.* The Reason he gives of it is, That the Church is a Body, of which Christ is the Head: And that as the Composition, Beauty and Conveniencies of the Body, require a variety of Members, so there must be likewise a variety of Gifts for the Compleatness, Splendor, and Service of the Church. Why then should not there be for the same Cause and Harmony, a difference in Natural Gifts, or in the very Essence and Nature of Spirits, since all the World is the Palace of God, in whose Construction great and little Stones may find a convenient place; and since by this variety, the Infinite Beneficence, Wisdom and Power of God, is more plainly manifested, as may be seen in the fore-mention'd XVII. Letter?

The 2d part of the 4th Question, *Whether Spirits are so far Subordinate to each other, as that the power of a Superior Spirit may altogether suspend the operations of an Inferior,* is very difficult to solve; and being the main Hinge of the whole Controversie, we cannot proceed too warily. As to God, the infinite Spirit, there is no doubt but that he can Suspend, and even alter the Operations of all other Spirits; but the Question is, Whether he will do it? for I have many pregnant Reasons for the Negative. God being the Goodness itself, has Created Spirits, or thinking Beings, to make them happy; but they cannot be so, unless they enjoy him, who is the Sovereign Good, as far as the reach of their Capacities will allow; and the Sovereign Good cannot be enjoy'd but by knowing and loving it. All Spirits therefore have been Created to know and love God. How comes it then that so many of them seem not to care for him? We must go up to the very Original of things, to find out the Solution of this hard Problem. Knowing is comparing things together; for without such a comparison, there is neither distinct Knowledge, nor lively Sensation. We know Pleasure by Pain, Health by Disease, Virtue by Vice, Harmony by Discord, &c. and therefore when God Created Spirits, he withal, or very soon after, Created Matter, the most imperfect of all Beings, since it's merely Passive, and destitute of all Sense and Knowledge; however 'tis such as may give a pleasant diversion to finite Spirits, by the diversity of forms it's apt to receive. I conceive that God gave power to these Spirits, to move and model some determinate Portions of this Matter, and perhaps united a confus'd sensation of Pleasure, to the Modifications they put it into, that they should the more willingly perform his Commands. In the mean while they were perfectly

fectly free; that is, They had an Absolute Power over their Will and Operations; Matter made no violent impressions upon them, but only such which they might suspend as they list'd, and always prefer Spiritual Pleasures to Material Sensations, if they would but consult their Natural Light, or the Idea's of the Infinite Wisdom, in whatever they undertook.

But that all did not do it, is too plain by Scripture and Tradition. Whether the fall'n Angels lost their Primitive Integrity, by neglecting Spiritual Meditations, and yielding too easily to confus'd Sensations; or whether they were seduc'd by the false promises of an Ambitious Spirit, as our first Parents were, I will not presume to determine. This only is plain to me, That there is an Evil Spirit, who is the chief of all the rest, whose Original Sin most probably was his endeavouring to Debauch, Seduce and Enslave his Fellow-Spirits, and to set up a Kingdom in competition with the Almighty. In this Rebellious design he still persists, and in reference to it, is call'd the *Devil, Satan*, or the Slanderer, the *Accuser of our Brethren*, who seduces all the World, the *Old Snake*, the great *Dragon*, a roaring *Lion*, that walks about seeking whom he may devour; and we are often forewarn'd to beware of him, and not to afford him an advantage over us. See *Isai. xiv. 12, 16. Mat. xii. 26. 2 Cor. xi. 3. 1 Pet. v. 8. Revel. xii. 9, 10, & xx. 2, 7, 8.*

And now the case is quite alter'd; for St. Paul says, *Know ye not that to whom ye yield your selves servants to obey, his servants ye are whom ye obey; whether of sin unto death, or of obedience unto righteousness*, Rom. vi. 16. A very remarkable Sentence. *Know ye not*, says the Apostle; 'tis then an undoubted Truth that we are Naturally free, but that we may lose that Liberty by a continu'd compliance, either with a Spirit of Rebellion, or with God's Commands. And as the good Angels have been confirmed for ever in their Primitive Integrity, and are become altogether impeccable, by an uninterrupted observation of Gods Laws; so the bad are become Absolute Slaves of their Passions, and withal, of one another, according to the several degrees of their Natural Power and Subordination, and have harden'd themselves for ever in their Apostacy, by an obdurate perseverance in their wicked and malicious Designs.

Thence I infer, that no Liberty, properly so call'd, can be ascrib'd either to good or bad Angels. For as to the good, they have intirely devoted themselves to God's Service; they never consult when he Commands, and do readily comply with each other, for that end, in their respective Stations: So that if they ever consult, or suspend their Judgment, 'tis only to chuse which way is the best,

when they have no exprefs Orders. As to bad Angels, they have conceiv'd such an inveterate hatred against the good, and against all the Creatures of God that have not yet totally Apostatized, that they never deliberate but to chuse the most pernicious methods to compass their malicious ends, and must either willingly or by force presently comply with their Tyrannical Superiors, for that purpose. See *Matt.* xviii. 10. *Heb.* i. 14. *Joh.* viii. 44. 2 *Pet.* ii. 4. 1 *Joh.* iii. 8. *Jud.* 6.

But as to Man, as he is yet in the state of Trial, he ought, it seems to be perfectly free, and so he was doubtless when he came first from the hands of God, *Eccles.* vii. 29. I shall not now inquire into the causes and manner of his fall, for that would carry me too far from my subject. I shall only suppose, as a truth that cannot be denied by any rational Divine, tho he were a Heathen, that there is a Corruption in Humane Nature, or that God did not Create Men as imperfect and wicked as they are, however that they are not for the most part so desperately corrupted, as to be past all hopes of recovery. Let's consider what will follow from thence

Men that are good or bad to extreams are few in number, and would not give us a true notion of the present state of Mankind. Let's then cast our Eyes upon the generality of men, who are, as I may say, neither too good nor too bad. The best of this sort may properly enough be compar'd to one that has been cur'd of a dangerous disease, but not so perfectly as to be wholly secure from all relapse; for he has now and then some little touches, or forerunners of his former sickness. If this man observe a good diet, and use from time to time proper remedies, he may at long run recover his health; but if he take no care of himself, he runs a hazard to fall worse than before: Every one understands that Ignorance, Self-love, Natural Pride, Voluptuousness and other passions are that perilous Disease, whereof a good Education, the Light of the Gospel, &c. may be suppos'd to cure us, tho never intirely in this life; so that we must perpetually stand upon our guard, otherwise we expose our selves to that dreadful fate threatned by our Saviour, *Matt.* xii. 43, 45. by *S. Paul*, *Hebr.* vi. 4, 8. and by *S. Peter* in his second Epistle, ii. 19, 22. *For of whom a man is overcome, of the same he is brought in bondage.*

I shall not enlarge upon the manner of the conversion of men, lest Criticks should say, that I write a Common Place instead of a Philosophical Letter; but from the Principles laid down before, draw the following conclusions. 1. All finite Spirits are naturally free, or have been created so. For as God is the supream Good,
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and deserves to be preferr'd to all others, so he will be lov'd by a free choice, and 'tis the height of happiness to know that our choice is the best. 2. The liberty of good Angels should rather be called a Spontaneity, for they perform their Duty most willingly, but never consult whether they shall do it; neither do they ever suspend their Judgments in reference to true or false, good or evil, because they never want light, and are not possess'd with prejudices and passions, so that they always chuse the truest and the best. And I cannot imagine any occasion, wherein they should suspend their Judgments, unless it be in some difficult circumstance, when they have no express Orders from God, but then their doubts may be quickly resolv'd, either by their natural light and acquir'd knowledge, or by the dictates of the Infinite Wisdom, who never fails to answer the expectation of their humble and earnest desires. 3. Bad Angels are most spontaneous and willing in doing evil, but not free at all, because they hate virtue and truth, and therefore will never choose it, unless it may accidentally serve their ends, or they be forc'd to it by God, who sometimes is pleas'd to restrain their malice. Besides their dependance on the Almighty, they are Slaves to each other, according to their natural subordination, or the agreement they have made amongst 'em, in and after their Apostacy. In general, Spirits that have taken a settled course of life, and do not want light to pursue their designs, are but improperly call'd free, for liberty and firm resolution are but opposite Terms. 4. Men only are properly free, since they only, for ought I know, are in a state of trial. Those that have given themselves over to their passions and prejudices, have almost lost their liberty, for they suspend their judgment very seldom, and act for the most part blindly. Sincere Lovers of truth and justice are the freest of all, for they rarely undertake any thing of consequence, without consulting the natural and the reveal'd Light, by attention and prayer. But those that are most confirm'd in wisdom and virtue are rather spontaneous than free, because they are so much us'd to the answers of the eternal truth, in what concerns their spiritual knowledge and salvation, that they understand it as in a moment. However they have still occasion of their liberty, because they are still liable to temptations, and that ignorance is inseparable from this mortal state.

Now I may solve the latter part of the fourth question and the first part of the fifth, with some certainty. 1. God ever had power to suspend the operations of all Spirits, but he thought not fit to use it whilst they underwent their Trial. 2. Now he works upon good Angels at their desire, or out of meer Beneficence. 3. He refrains

refrains the malice of Devils and wicked Men, and often forces them to speak the truth against their Will; and even sometimes to promote Virtue, and to be the Executioners of his Judgments. All which he does either by a direct influence, or by the unfearchable Springs of his Wisdom. 4. He acts upon good Men by his ordinary Grace, and sometimes by the inspiration of the H. Ghost, and Supernatural Gifts; for tho they be in a state of Trial, yet their Natural Light and Liberty being much impair'd by their fall, they should not be able to withstand their passions, and the assaults of the Devil, without the Coelestial assistance. 5. Good Angels act upon each other, when they exchange, as I may say, their Thoughts; they may likewise, by the order or leave of God, act upon Just Men, either by assuming Corporeal shapes, and speaking sensibly with them, or by moving the Nerves and Fibres of their Brain, in the way that is requir'd to raise such and such Thoughts, to pronounce such and such Words, or to perform such and such Actions; but they have nothing to do with the Wicked, unless it be to oppose, or punish them by God's Command. 6. Bad Angels may suspend the Spiritual operations of their Slaves, for they deal with them with a more than Arbitrary and Tyrannical Power. As to Just Men, tho they may sometimes by Gods permission vex them in their Goods, and even in their Body, yet they have nothing to do with their Mind. And therefore if there be now Men really posses'd with the Devil, I have not much better opinion of them then of Wizards and Witches; for *resist the Devil and he will flee from you*, Jam. iv. 7. Had those Men given no room to the operations of that wicked Spirit, by Melancholy, Murmuring, Blasphemy, Despair, or some other grievous Sin, 'tis not conceiveable God would have granted him such a great power over them. But most of the Stories of this Nature, which I have examin'd, prove meer Cheats, as I shall make it appear in some other Letter. And if somebody vouchsafe to send me faithful and well attested Relations concerning this matter, I doubt not but that I shall be able to explain them by the Principles I have laid before, and shall set down hereafter.

Perhaps the greatest part of Readers would have been better pleas'd that I had related some strange Stories, and made a short Comment upon them, than to follow me through this long and troublesom way of Reasoning; for most People are as much tir'd by Reading Metaphysical Discussions, as their Authors by setting them up, without considering that this Method, how tedious soever it appears, is the only sure way to attain to Knowledge; so that

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that I foresee I shall have but little thanks for my pains. But if you approve of them, and vouchsafe to help me, in order to Correct and Improve my Notions, I shall esteem them not altogether unprofitable; for I am confident every unprejudic'd Philosopher and Divine, that has Read what you have Writ concerning Tradition, will agree with me, That I have made choice of as good a Judge of Metaphysicks as any there is in the World.

September 26.

L E T T E R XXXVIII.

To the Honourable Sir Robert Southwell,
President of the Royal Society.

A R G U M E N T.

The Author's unwillingness of entering upon Controversies. His Quotation of a passage out of Mr. Newton's Principia Mathematica clear'd. The Hypothesis of the II. Letter of these Memoirs grounded upon the Demonstrations of Mr. Newton and Huygens. An Experiment to make sensible the force of the Circular Motion, and the inequality of the Diameters of the Earth. What Proportion there is betwixt the quantity of void Spaces, and the quantity of Matter in this Globe. The Theorist's Philosophical and Anatomical mistakes. How the Earth after the Flood came insensibly again to its former Equilibrium, by the foremention'd Proportion? That Proportion is demonstrable. The Possibility of a motion of the Earth far swifter than its diurnal circulation. A wholesome Advice to the Theorist.

Honourable Sir,

WHat the Wisest of Kings said, That of making many Books there is no end, and that much Study is a weariness of the flesh, is especially true of Publishing new Hypotheses, for one cannot certainly tell where he shall stop. Those Thoughts concern-

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ing the formation and drowning of the Earth, which I had set up for your diversion, rather than any other insight, have met with so many Curious Examiners, that I fear lest I be insensibly forc'd, against my first Resolution, to *Compose huge Volumes in their Defence.*

Some Criticks, not very Learned however, have pick'd a suppos'd fault out of the end of the XXI Letter of these *Memoirs*, where I say, that *I could alledge the Authority of that Incomparable Mathematician Mr. Newton, if Philosophers were to be convinc'd that way, because he thinks that even now the situation I have given to our Globe, viz. to turn upon its shortest Diameter, and to be set upright upon the longest, is requir'd to keep the Waters down; and therefore the overflowing of the Sea is a necessary consequence of the inclination of the said Globe.*

It's pretended that I have mistaken Mr. Newton's Opinion; but this is a Matter of Fact that can be quickly decided, and I leave you, Sir, and every other Learned and Impartial Reader, to judge of it. The passage which I allude to is contain'd in the 3d Book, the 17th Theorem, where he proves this Proposition, *The Axes of Planets are shorter than the Diameters that are drawn upon them*, in the following manner. "Had not the Planets a Diurnal motion, as their parts lay equally heavy upon one another, so they would be perfectly Spherical; but this Circular motion causes the said parts to remove from the Axis, and to tend upwards to the Equator. And therefore if Matter be fluid, it will increase the Diameters of the Equator by its ascent, and diminish the Axis of the Poles. Thus the Observations of Masters *Cassini* and *Flamsteed*, agree in this, That the Diameter of *Jupiter* is observ'd to be shorter betwixt the Poles than from East to West. And by the same reason, were not our Earth a little higher under the Equator than under the Poles, the Seas would subside towards the Poles, and ascending along the Equator would overflow all. *Eodem Argumento, nisi Terra nostra paulo altior esset sub Equatore quam ad Polos, Maria ad Polos subsiderent, & juxta Equatorem ascenderant, ibi omnia inundarent.*

Then he goes about this Problem, *To find the Proportion of the Axis of a Planet to the Diameters that are perpendicular to it*, which he makes out by the following Principles. That the force, by which the Circular motion drives upwards the parts of the Earth under the Equator, is to the Natural Gravity by which they tend down to the Center as 1 to $29\frac{1}{2}$; so that if there were a Canal full of Water going from one Pole to the other, and another perpendicular to it from the *Zenith* to the *Nadir*, the Gravity of the Water running from Pole to Pole would be to the Gravity of the Water descend-

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ing along the Equator, as 291 to 290, because the force, by which the Circular Motion, causes the parts of the Equator to remove from the Center, would Counterbalance $\frac{1}{21}$ of their natural gravity. 2. Then comparing the gravity of bodies towards the Poles and the Equator, supposing the Earth to have no motion, with the force of the Circular motion by which its Diameters are made unequal, he finds that the gravity towards the Poles is to the gravity towards the Equator as 501 to 500. But 3^{dly} by the third Corollary of the 91 Proposition of his first Book, it appears that the gravity of bodies in different places, is as the distance of those places from the Center of the Planet. And therefore 4^{thly} that the Diameter of the Equator is to the Axis of the Earth, as 692 to 689; whence follows 5^{thly} that the said Axis being 19615800 foot of *Paris* equal to 3923 miles and 800 foot, according to the accurate calculation of Mr. *Picard* a French Mathematician, the height of the Earth at the Equator surpasses its height at the Poles by 85200 foot, or 17 miles and 200 foot, allowing 5000 foot to a mile.

I have related these Passages somewhat at length, to shew that Mr. *Newton*, not only admits the principle of the inequality of Diameters in the Terraqueous Globe, upon which my Hypothesis is built, but even demonstrates it *à priori*; so that the *Pendulums* shortning their Vibrations, as they are brought nearer to the Equator, is no more than a necessary consequence of this inequality of Diameters: The demonstration is plain to any Mathematician; but to make it sensible to others, Let 'em take a hollow glass-ball, pierced only with a little hole, through which let 'em almost fill it with water, and throw into it a handful of *Spanish* wax beaten to small Powder, stop the Vessel and place it on a pin, whereupon it may freely turn. They will observe that the particles of the wax, being somewhat heavier than the watery corpuscles, will sink down to the bottom of the Glass. Then let 'em give a swing to the Vessel, and the Water together with the Wax Particles will rise from the bottom along the sides of the Glass to its uppermost superficies, and continue so as long as the rotation is violent; but proportionably as it abates, the Wax, as the heaviest, will sink down to the bottom again, the Water, as the lightest, keeping up longest to the uppermost superficies, till it be also depressed to its former level, by the Air extricating it self, when the motion is wholly ceas'd.

It's evident in this instance that if the sides of the Glass did not contain the Water and Wax within bounds, they would swing away by the violence of the rotation; and so it would happen to the parts of the terraqueous globe, were not the world almost full with

matter, or as full as ever it can hold. But as I have observ'd in the XXIX Letter, there are little void spaces interspers'd amongst bodies, because the first corpuscles they are made of are globulous, and that motion cannot be conceiv'd in the opposite Hypothesis; but these first globules are so very insensible, that the interstices they leave amongst 'em must needs be of an unconceivable smallness. And therefore the matter of the terraqueous globe cannot fly away by its diurnal rotation, because 'tis kept down by other matter to an indefinite distance, only it can ascend along the Equator to a height proportionable to the quantity of void spaces; which, methinks, I can pretty near determine by the joint computations of Master *Newton* and *Huygens*, and say that in the terraqueous globe the quantity of void spaces is to the quantity of matter, as the length by which the Diameters of the Equator surpass the Axis of the Earth, that is, as 1 to 290, according to Mr. *Newton*, or as 1 to 289, according to Mr. *Huygens*.

Perhaps it will be objected, that this quantity of void spaces is inconsiderable, in relation to such a vast quantity of matter. But I answer first, That I see no pregnant reason, why there should be a far greater number of them. Secondly, That this suffices to conceive the possibility of motion. Thirdly, That globules so prodigiously small as the first corpuscles are, can be so complicated and crouded, that the interstices, they leave amongst 'em taken together, amount but to a very small quantity. Fourthly, That Condensation and Dilatation, the Phenomena must usually alledg'd to prove the necessity of void spaces, cannot be intirely solv'd by that supposition; but that there must be besides a very insensible matter going out and into the condens'd and dilated bodies. Fifthly, That no probable cause can be feigned of the proportion betwixt the force of the diurnal circulation, and that of the natural gravity of bodies, unless the quantity of void spaces and that of matter be in the same proportion, as I shall prove hereafter.

By this I am sufficiently clear'd from all mistake as to the sense of my quotations, since it appears that the Principles of Mr. *Newton* and *Huygens* agree perfectly with mine, tho it may be those great Mathematicians never thought on the consequences I have drawn from thence, in order to explain the possibility of the Deluge, by the overflowing of the Sea. But I must make you admire the Philosophy of the *Builder of the new World*, as all Christians have been justly surpriz'd at his Divinity in reading his *Archæologia*. From the foremention'd Demonstrations 'tis plain, that the figure of the earth is some what oblong, so that our globe is rather a spheroid, than a sphere; which may have giv'n occasion to those

those expressions of the Ancients, the Theorist boasts so much of (a). (a) *Tellur.*
 But withal it appears that the Axis is the shortest Diameter, and that *Theor. Sacr.*
 tho it were suppos'd that it was at first the longest, yet it could not *l. 2. c. 10.*
 remain so during many years, much less 16 or 17 ages, as this new
 Philosopher pretends, except that we imagin, against all reason and
 experience, all the parts of the superficies of the earth as hard and
 contiguous as the parts of Diamonds. But if we suppose them soft
 and fluid as ever they were, and probably more at the beginning
 than they are now; it follows, that since the circular motion resists
 the natural gravity of bodies under the Equator, with the force of
 1 to 290, in 290 days the Earth would have grown perfectly spheri-
 cal; and in 290 others, have taken the form of a spheroid turning
 on its shortest diameter; yet not farther receded from the globular
 figure, because matter cannot be driv'n more upwards than the
 quantity of void spaces will allow.

Mr. *Newton's* passage has made me take notice of another splendid
 mistake of this Author. Master *Cassini* and *Flamsteed* have observ'd
 the diameter of *Jupiter* to be longer East and West, than North
 and South; and this excess must not be inconsiderable, to be per-
 ceiv'd at so great a distance. Mr. *Newton* calculates it as exactly as
 can be done, saying, since *Jupiter* turns about its center, or makes
 its diurnal revolution in reference to the fix'd Stars, within 9 hours
 56 minutes, and since the squares of times are in proportion as 29
 to 5; it follows that the difference betwixt the longest diameters of
 this Planet and the shortest are, as 1 to $39\frac{3}{4}$, or that the diameters
 from East and West and from the Zenith to the Nadir, perpendi-
 cular to the Axis of *Jupiter*, are to the said Axis, as $40\frac{3}{4}$ to $39\frac{3}{4}$. But
 our Theorist, more us'd to phanciful dreams than to geometrical
 calculations, will tell you, (b) *As to the Belts of Jupiter, which are the* (b) *Theor.*
most remarkable Phænomenon of that Planet, I take them to be his Zones, and of the
to be parallel with one another; and I believe also with his Equator—If *Earth. B. 1.*
we have guess right that Jupiter is in an Antediluvian State, I should rather *Ch. 12.*
expect to find the figure of his Body, than of any other of the Planets, to be
oval or oblong, such as our Earth was before its Deluge.— (c) *The Globe* (c) *1b. B.*
of the Earth was (before the Flood) *really divided into so many Regions* *11. Ch. 8.*
of a very different aspect and quality, which would have appear'd at a di-
stance, if they had been look'd upon from the Clouds, or from the Moon as
Jupiter's Belts, or as so many Girdles or Swathing bands about the body of
the Earth. The second Edition of the Theory in English, is printed
 4 years after Mr. *Newton's* book; and one would think that an Au-
 thor, who should have more love for the truth, than affection for
 Witticisms and an outward shew of Learning, would not be asham'd

(a) *Theoria*
SACRA
Telluris.

of mending any faults upon the demonstrations of that great Mathematician. But besides the loss of many pretty thoughts, the Theorists Rivers would have been quite stopp'd, and his Antediluvian Earth have remain'd as dry as the Desarts of *Lybia*. And what means then of presenting two Kings and a Queen with an imaginary world, of boasting to have retriev'd a World, that had been lost for some thousand years, out of the Memory of Man, and the Records of Time, or of setting up for Author of a Sect of Utopian Philosophers. *Cassini*, *Flamsteed*, *Newton*, are great names, but what signify their observations and demonstrations, since *Moses* himself loses his sacred Authority, when he stands in competition with the sacred Theory of the Earth, as its Author, and several Divines call it, but (a) in a contrary sense?

However, if I cannot flatter the Ambition of Princes with the promise of enlarging their Dominions, and the proffers of New-found Land and Countries, I have this satisfaction, that the Holy Writ, as well as Astronomical and Geographical Observations, conspire as much to establish my Hypothesis, as to overthrow that of my supercilious Adversary: As now Mr. *Newton's* and *Huygen's* Demonstrations open to me a new way to explain how the Earth return'd by degrees to its former Equilibrium, after it had lost it by the unusual Earthquakes, Eruptions, Tempestuous and unequal Rains, that preceded and accompanied the Deluge, and that precisely in the time set down by the H. Writer.

For supposing as in the Scheme of the 2d Letter of these Memoirs, p. 12. the Sea lying round about the Earth, as betwixt the Ovals NC, ED, SF, GW; but after it was fall'n (as it were) upon its longest Diameter EW, the Waters in WNE overflowing the Earth in MLCI, the Waters in ESW, the Earth in DFGO; since the Diurnal Circulation of the Terraqueous Globe was not interrupted, it follows that the force of that Circulation withstood still the Natural Gravity that carries Bodies down to the Center, and was with it, at least in the same proportion as 'tis now, that is, as 1 to 290. But we have reason to believe, that that proportion was then far greater. 1. Because, tho the Superficies of the Earth be now for the most part, either soft or fluid, yet 'tis interwoven with divers hard Bodies, whereas it was then cover'd all over with a Liquid. 2dly. Because the many Earthquakes, Eruptions, Winds and Rains, that preceded and accompany'd the Deluge, had put all the parts of the Earth at a considerable distance from its Superficies, in such a violent Commotion, that it render'd them fitter to propagate the vehemence of the Diurnal rotation, and to resist the natural gravity, with greater force than they do now. 3dly.

3dly. And therefore the Sacred Historian fixes the time of the prevailing of the Waters over the Earth to 150 days, *Gen. vii. 24.* during which it may be suppos'd, that by the force of the Diurnal Circulation, the Waters ascending from the Poles, North and South, towards the Equator, the Terraqueous Globe took a Spherical Figure.

Julius Africanus, a Christian Chronologer, whose Chronicle *Eusebius* thought fit to insert in his, as being the most accurate of his time, assures us that the Years of the H. Writ are of 12 Months, and the Months of 30 days, making in all 360 days. But we need not have recourse to Humane Authority, for, from the 1st day of the 10th Month, to the 1st Day of the 1st Month in the next following Year, *Moses* reckons 40 Days and 3 Weeks, that is 60 or 61 days, *Ch. viii. v. 5, 13*: Which is very observable, and shews that the abating or sinking of the Waters down to the Poles followed the increase of the Equinoctial diameters almost geometrically. On the 17 of the 7 month (77 days after the Terraqueous globe had taken a spherical figure, and when the proportion betwixt the Circulation and Gravity was already as 77 to 22330) the Ark rested on the Mountains of *Ararat*, which most probably were the highest of those whereon that Vessel swam: On the 1st day of the tenth month, the proportion being as 150 to 43500, the tops of the Mountains were seen. 54 days after, both forces being in proportion as 204 to 59160, the Waters were so far retir'd, as to let appear the summities of such Trees as grow in the Plains: And on the 27th of the 2d month, or 13 month 27 days after the beginning of the Flood, when the proportion was as 268 to 77720, that is almost the same as 'tis now, or as 1 to 290, *Noah* and all his Family, with all the Animals he had preserv'd alive, went out of the Ark, a great part of the Earth being sufficiently dry'd, because God had rais'd a Wind to drain it, proportionably as the Waters retir'd towards the Poles, or sunk into the Canals and Plashes they had digg'd during their stay upon the ground.

It's worth our inquiry to examine why that proportion betwixt the force of the diurnal Circulation, and the natural gravity should be so constant. I have already said, that I could find no probable cause, unless it were this. *As the excess by which the Diameters of the Equator surpass the Axis, is to the same Axis, or as the force of the diurnal Circulation to remove bodies from the center of the Earth is to the force of the natural gravity to carry them down to the said center; so is the quantity of void spaces to the quantity of matter in this our Globe.*

For, because Circulation is an active principle, whereas heaviness

is.

(a) Lett.
xxxvii.

is a passive quality, proceeding only from the impenetrability and unactivity of matter; tho the disproportion betwixt both be so very great, yet in process of time the former would gain upon the latter, as upon an enemy that can make no resistance of its own, (a) if matter could be driven up higher than the summit of the Equator, from the top of the Atmosphere of an orb to its center, that is higher than the present quantity of void spaces will allow. As in the instance formerly mention'd, the Water and Wax would be flung out of the Ball, were they not kept within by the sides of the Glass.

This Hypothesis is very agreeable with the Phenomena, and, methinks, I could by its means solve a great number of difficulties in Physicks. At present I shall content my self with observing that it gives a very probable account of the possibility of motion, and of the nature of gravity: We need not have recourse to any imperceptible Matter, or magnetical Virtue. Bodies go down to the center, because they are unactive and impenetrable; so that were the diurnal motion superseded but one day, they would replenish all the interspers'd vacuities, and jump into a Chaos not much unlike to the former.

(b) *Di. c.*
de la cause
de la pesin-
teur. p. 157.
Lev. de 1690.
(c) Lett.
xxi. p. 168,
169. Lett.
xxxi. p.
241, 242,
243.

I have observ'd in Mr. *Huygen's* ingenious Treatise concerning the cause of gravity (b) a Corollary that will give a great light to the conjectures I have publish'd in former Letters, (c) viz. That to disentangle the parts of the Chaos, God gave it a motion 40 or 48 times swifter than its diurnal circulation. Mr. *Huygens* says, that if the diameter of the Equator should be double of the Axis, and the Earth turn 17 times swifter than it does now, the force of that circulation to remove bodies from the center would be equal to their gravity; but if it should be more vehement, the bodies at the summit of the Equator would fly into the Air. Suppose it then 26 times swifter, the diameter of the Equator will be $3\frac{1}{17}$ longer than the axis, and the Terraqueous Mass will be neither a globe nor a spheroid, but have the figure of two *Parabolæ* join'd together by their extremities. And as the violence of that motion would have been more than sufficient, to sever the various bodies of the confus'd congeries; so, the great declivity of the *Parabolæ* would have carried the Waters down to the Poles in a day or two. So that the more I meditate upon *Moses's* account, the more rational I find it.

According to the same Author, (d) there is still a fluid matter that has a swiftness 17 times greater than the diurnal circulation of our Globe, for it resembles a body, that should turn about its superficies in the space of an hour $24\frac{1}{2}$ minutes. And lest this motion should appear too violent, he proposes to imagine a physical point advancing only a degree upon an ordinary geographical Globe, within

in 14 seconds, which is the space that this fluid matter runs through within such a time; for this motion will seem to be slow, rather than swift.

I could wish I had more time to digest these *Memoirs*, I should not be so often at correcting or improving my notions. But I am like the blind man of *Bethsaida*, who at the first touch of our *Saviour* saw men as trees. *Mark viii. 29.* And it can hardly be otherwise in my unhappy circumstances, when I have scarce any other help, but my own meditation. And therefore I am so far from having less regard for Dr. *Burnet's* parts, because of any mistakes I may observe here and there in his Writings, that I would have as great an esteem of his sincerity and modesty, as I have of his Learning, if he were pleas'd publickly to declare, that he did not write his *Archæologia* for vulgar capacities, since he seal'd it up in the Tongue of the Learn'd, that he has propos'd many things that are taken as his direct opinion tho they be bare objections; that if he seem inclin'd to give an Allegorical interpretation to the first Chapters of *Genesis*, 'tis meerly by reason of the difficulties of the literal sense; and that there are some things in his Books, which he would willingly mend if he were to write again.

LETTER XXXIX.

To Mr. *Reve Williams* Mathematician.

ARGUMENT.

Theorems to find the beginning of the Twilight, the Declination of the Sun being North, South, or in the Equinoxes. How to find when it finishes at night.

Honour'd Sir,

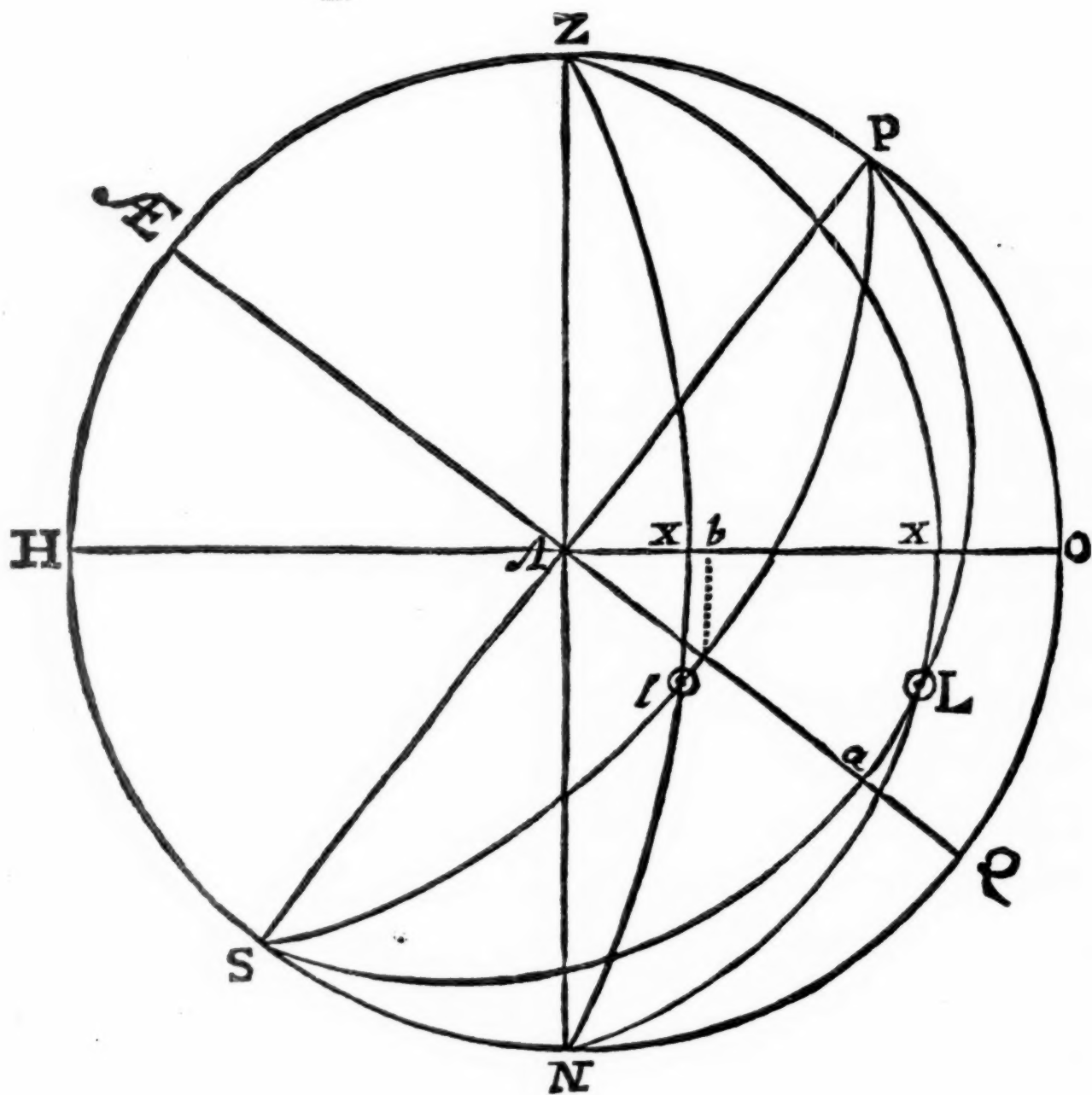
I Present you with some Theorems, that may be of use in that excellent Art, in which you prove so serviceable to your Country, I mean Navigation. For by their help we may find to a 2^d the precise

precise hour of the day, a considerable time before the Sun's rising and after its setting. Let it then be propos'd.

To find the time when *Twilight* begins at any day of the year, the *Latitude* of the *Place*, and the *Declination* of the *Sun*, or its distance from the *Equator* being given.

This Problem may be geometrically solv'd, as will appear in three instances, which I shall set down here instead of all the 365, or 366 operations, that may be made according to that pattern.

Make the following Diagram



in which POQNSHÆZ represent the Meridian, HAO the Horizon, ÆAQ the Æquator, Z the Zenith, N the Nadir, P the North-Pole, S the South-Pole, XL the Crepuscular Arch, or the Sun's

Sun's depression under the Horizon (*viz.* 18 degrees) *L* the Sun's Declination to the North.

I. Let's then take for the first instance the Latitude of *London* 51 degrees 32m. and suppose the North-declination to be 10 degrees. Because in the Spherical Triangle *ZPL* there is given *ZL* the distance of the Sun from the Zenith, 108 d. *ZP* the complement of the Latitude 38^d. 28', *PL* the complement of the Sun's Declination 80^d., we have but to find the Angle *ZPL*, which may be done by this Proposition.

As the Rectangle of the Sines of the Sides ZP mult. into PL (a) containing the Angle sought is to the Square of the Radius's (b) so is the Right-angled figure of the Sines of the $\frac{1}{2}$ Sum (c), and $\frac{1}{2}$ difference of the Base (d), ZL, together with the difference of the Sides PL—ZP (e), to the Square of the Sine of $\frac{1}{2}$ the Angle sought.

Logarithms.	
(a)	19. 7871832
(b)	20.
(c)	19. 7232861
(d)	20. Add
(e)	39. 7232861
	Sub. 19. 7871832
	Rem. 19. 9361029

The half of the Remainder, 9.9680514, gives the Logarithm of 68^d. 18', which being doubled make 136^d. 36' for the Angle sought *ZPL*; subtract this from the $\frac{1}{2}$ of the circumference 180^d. remains 43^d. 24'; convert them into time, and you'll have 2^h. 53' 36" for the beginning of the twilight.

II. Let's now give an instance when the Sun removes to the South, and suppose the Declination to be 5^d. in the same Latitude. Because in the Triangle *SLN*, *LN* the distance of the Sun from the Nadir 72^d., *SL* the complement of the Sun's Declination 85^d. *SN* the complement of the Latitude, 38^d. 28', are giv'n, there remains but the Angle *LSN* to be found; which is done by this Canon.

As the Rectangle of the Sines of the Sides LS mult. into SN containing the Angle sought (a) is to the square of the Radius (b): So the Rectangle of the $\frac{1}{2}$ Sum (c) and $\frac{1}{2}$ difference of the Base NL (d), together with the difference of the sides LS—SN (e) is to the square of the Sine of $\frac{1}{2}$ the Angle sought.

Logarithms.	
(a)	19. 7921759
(b)	20.
(c)	19. 2775123
(d)	20.
	Add.
(e)	39. 2775123
	Sub. 19. 7921759
	Rem. 19. 4853364

The Bisection of the Remainder 9. 7426682, is the Logarithm of 33^d. 34' the double of which is 67^d. 8' the Sine of the Angle sought *NEL*: convert this into time, and you'll have 4^h. 28' 32" for the beginning of the Twilight.

III. When the Sun cuts the Equinoctial, the operation may be made as before, but because it may also be done by a Theorem that is less troublesome, I shall set it down here, and the proof by Logarithms in the Margin. Imagine only *ab* to be the Arch of an Azimuth, and the quantity of it to be 18 degrees. Then say. *As the Sine*

T t

of

Logarithms.

(a) 9. 7938317

(b) 10.

(c) 19. 4899824

(d) - 9. 7938317

Rem. 9. 6961507

of the complement of the Latitude (a) O Q (viz. $38^{\circ} 28'$ is to the Radius; (b) so the Sine of a b viz. 18° . (c) is to the sine of a A, that is less (d) $29^{\circ} 47'$ subtract them from 90° . remains $60^{\circ} 13'$, which converted into time give $4^h 52''$ for the beginning of the Twilight.

I know that the refractions light may suffer through Vapours, Exhalations and Clouds may oft in such things hinder a compleat agreement betwixt practice and speculation. But besides the pleasure that there is in knowing Geometrical Truths, such a competent abatement may be made for these Refractions, as that the propos'd Theorems will be useful in any place, and for the most part of the year.

To find out the duration of the Twilight, or at what time it finishes after Sun's set, you need but know exactly the time of the Sun's rising and setting, then having made your operation for that day, and found the beginning of the Crepuscle, add to the Sun-set the time that passes betwixt the beginning of the Twilight and the Sun-rise, and 'twill give the time of night that the Crepuscle finishes. This, Sir, is not written for you, but for young Scholars, to which I wish that these *Memoirs* may also prove useful.

M^r. Bernoulli's Canon for finding the shortest Twilight prove likewise Geometrical, but the Demonstration is too long to be inserted here.

F I N I S.

ERRATA in July.

Page 226 line 41 for 1593, read 1573 or 1574. l. 42 add after Montpelier 1593. p. 227. l. 2. Lewis xiii r. Henry iv. l. 3. 1621 r. 1611.

In August,

Page 257 line 16 of in Terms blot out in

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F I N I S.